Regional Information Report No. 4K19-10

Special Project Plan: 2019 Large-Mesh Bottom Trawl Survey of Crab and Groundfish for Kodiak, Chignik, South Peninsula, and Eastern Aleutian Districts

by

Michael Knutson

May 2019

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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SPECIAL PROJECT PLAN: 2019 LARGE-MESH BOTTOM TRAWL SURVEY OF CRAB AND GROUNDFISH FOR KODIAK, CHIGNIK, SOUTH PENINSULA, AND EASTERN ALEUTIAN DISTRICTS

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ABSTRACT

This report specifies special project objectives and methods and presents survey schedule and station boundaries of Alaska Department of Fish and Game's (ADF&G) 2019 Kodiak, Chignik, South Peninsula, and Eastern Aleutian districts large-mesh bottom trawl survey of crab and groundfish. This special project plan is used in conjunction with the large-mesh bottom trawl survey operational plan (Spalinger 2015), which describes standard large-mesh trawl survey sampling. Special projects for 2019 include performing a fishing power comparison between the R/V *Resolution* and the R/V *Solstice*, sampling shrimp and forage fish using small-mesh trawl gear in Pavlof and Chiniak bays, and examining Tanner crab *Chioneocetes bairdi* for signs of black eye pathology.

Key words: Tanner crab, shellfish, groundfish, trawl survey, Kodiak, South Peninsula, Chignik, Eastern Aleutian, special projects

INTRODUCTION

From June through September 2019, the Alaska Department of Fish and Game (ADF&G) will conduct a bottom trawl survey in areas of known Tanner crab *Chionoecetes bairdi* habitat around Kodiak Island, south of the Alaska Peninsula from Cape Douglas to False Pass, and around the Eastern Aleutian Islands using a fixed-grid station design (Figure 1). Survey data is used to estimate relative abundance, sex composition, and maturity of Tanner crab and red king crab *Paralithodes camtschaticus*, as well as determine spatial distribution, species composition, density, and size frequency distribution of groundfish species. Standard sampling methods during the bottom trawl survey are described in the operational plan (Spalinger 2015). This report details sampling methods for special projects, survey schedule, and station boundaries for the 2019 large-mesh bottom trawl survey. Additional equipment required for special projects are detailed in Appendix A.

OBJECTIVES

Objectives for special projects during the 2019 large-mesh bottom trawl survey are:

1. Conduct paired tows using ADF&G research Vessel (R/V) *Resolution* and R/V *Solstice* to quantify species specific differences in fishing power between the two vessels.
2. Conduct small-mesh hauls in Pavlof and Chiniak bays, sampling shrimp and forage fish to continue the small-mesh time series in those areas.
3. Examine Tanner crab for signs of black eye pathology.

METHODS

SURVEY AREA

The 28.3m R/V *Resolution* will conduct survey hauls using a 400-mesh eastern otter trawl in the Kodiak, Chignik, South Peninsula, and Eastern Aleutian Tanner crab districts (Figure 1, Appendices B1–B14). This area includes waters of the Pacific Ocean south of the latitude of Cape Douglas (lat 58°51.10'N), west of long 149°W, and east of long 172°W, and Bering Sea waters south of lat 54°36.00'N and east of long 172°W. The 2019 large-mesh bottom trawl survey will sample 372 stations representing approximately 13,148 km^2.

FISHING POWER COMPARISON STUDY

The R/V *Resolution* underwent substantial structural and mechanical upgrades in the winter of 2017/2018. To preserve survey time series continuity the R/V *Resolution* and R/V *Solstice* (17.4 m) will continue a study that began in 2015. Vessels will perform paired tows in the Northeast and

Eastside sections of the Kodiak Tanner crab Districts (Figures 2–4) to estimate species specific fishing power correction factors between the vessels. Results from this study will provide a link between data collected by the R/V *Resolution* prior to the upgrades and data collected by the vessel in its current configuration. Details on this study, including data analysis methods can be found in Spalinger (*in prep*).

PAVLOF AND CHINIAK BAY SMALL-MESH HAULS

Since 1973, either ADF&G or the National Marine Fisheries Service (NMFS) have conducted small-mesh bottom trawl surveys in the Kodiak, Chignik, and South Peninsula districts using a high-opening box trawl. This survey was conducted annually in Pavlof Bay, Chiniak Bay, and other areas. In 2015, funding was reduced to a level where an independent small-mesh survey was no longer possible. To maintain the Pavlof Bay small-mesh data time series, and provide a baseline to monitor shrimp populations, the R/V *Resolution* will perform a limited number of small-mesh hauls during the 2019 large-mesh survey.

Near the end of the South Peninsula large-mesh survey leg, vessel staff will remove and store the large-mesh trawl net and replace it with small-mesh trawl survey gear. Up to 8 hauls will be conducted in randomly-selected small-mesh survey stations in Pavlof Bay (Figure 5) and the catch will be sampled according to small-mesh bottom trawl survey methods (Jackson 2003). Upon completion of those hauls, the large-mesh survey gear will be reinstalled, and the large-mesh survey will continue.

After completion of the large-mesh survey, the large-mesh trawl net will again be removed and replaced by small-mesh gear. Up to 8 hauls will then be conducted in randomly-selected small-mesh survey stations in Chiniak Bay (Figure 6) during 2 separate day trips. Catch from those hauls will be sampled according to small-mesh survey methods (Jackson 2003).

TANNER CRAB BLACK EYE PATHOLOGY MONITORING

A pathology causing discoloration and necrosis of eye tissues (black eye) was recently recorded in snow *C. opilio* and Tanner crabs from the Bering Sea. A subset of Tanner crab will be examined throughout the 2019 ADF&G large-mesh trawl survey to gather information on the prevalence and geographic extent of this pathology in the Gulf of Alaska. A minimum of two hauls will be sampled each day; For each sampled haul, at least 25 male and 25 female Tanner crab will be examined by the cruise leader for symptoms related to black eye pathology. Crab exhibiting black discoloration within the eye interior or the surface of the cornea will be considered positive for black eye pathology (Appendix C1). Crab determined to be positive will be measured and associated biological information will be recorded on provided data form (Appendix C2). At the conclusion of the survey, all associated data will be provided to Kodiak ADF&G research staff for documentation and analysis.

DATA CUSTODY

The cruise leader will download electronically collected data to the vessel's survey computer and create backup copies of all electronic data to an external hard drive, USB flash drive, or other location daily. At the end of each survey leg the cruise leader will ensure all samples and data forms are completed and taken directly to the lead trawl survey biologist, including electronically collected data. For projects continuing to the next survey leg, data forms will be organized, labeled, and dried. Forms will be stored according to project and ordered sequentially by haul. Sampling logs will be completed and kept with data forms for reference.

PERSONNEL AND SURVEY SCHEDULE

R/V Resolution crew - Captain Denis Cox Jr., Kurt Pedersen, Gary Wilson

	Paired tows *June 2-10*	*Chiniak Bay* *June 13 and 14*	*Marmot Bay* *June 19-21*	*Eastside Kodiak, and Alitak* *June 26-July 12*
Cruise Leader:	Natura Richardson	Kally Spalinger	Kally Spalinger	Natura Richardson
Biological Crew:	Collin Hakkinen Sherry Barker Joy Brooks	Collin Hakkinen Sherry Barker Joy Brooks Michael Knutson	Collin Hakkinen Sherry Barker Joy Brooks	Collin Hakkinen Sherry Barker Joy Brooks

	Unalaska, Peninsula, and Chignik *July 18-Aug. 22*	*Westside Kodiak and Shelikof Strait* *Sept. 3-13*	*Chiniak Bay small-mesh* *Sept. 18 and 19*
Cruise Leader:	Nathaniel Nichols (First half) Michael Knutson (Second half)	Kally Spalinger	Kally Spalinger
Biological Crew:	Collin Hakkinen Sherry Barker Joy Brooks	Collin Hakkinen Sherry Barker Joy Brooks	Collin Hakkinen Sherry Barker Joy Brooks Michael Knutson

R/V Solstice crew - Captain David Anderson, James Weise, Clayton Hamilton

	Paired tows *June 2-10*
Cruise Leader:	Kally Spalinger
Biological Crew:	Nat Nichols Michael Knutson

REFERENCES CITED

Jackson, D. R. 2003. Project operational plan: Small-mesh bottom trawl survey of shrimp and forage fishes: Kodiak, Chignik, and South Peninsula districts. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 4K03-47, Kodiak.

Spalinger, K. 2015. Operational plan: Large-mesh bottom trawl survey of crab and groundfish: Kodiak, Chignik, South Peninsula, and Eastern Aleutian management districts–standard protocol 2015–2019. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF.4K.2015.20, Kodiak.

Spalinger, K. *In prep*. Operational plan: Estimation of fishing power correction factors for the R/V *Resolution* relative to the R/V *Solstice*, using large-mesh bottom trawl survey gear in the Kodiak District, 2019. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Operational Plan, Kodiak.

FIGURES

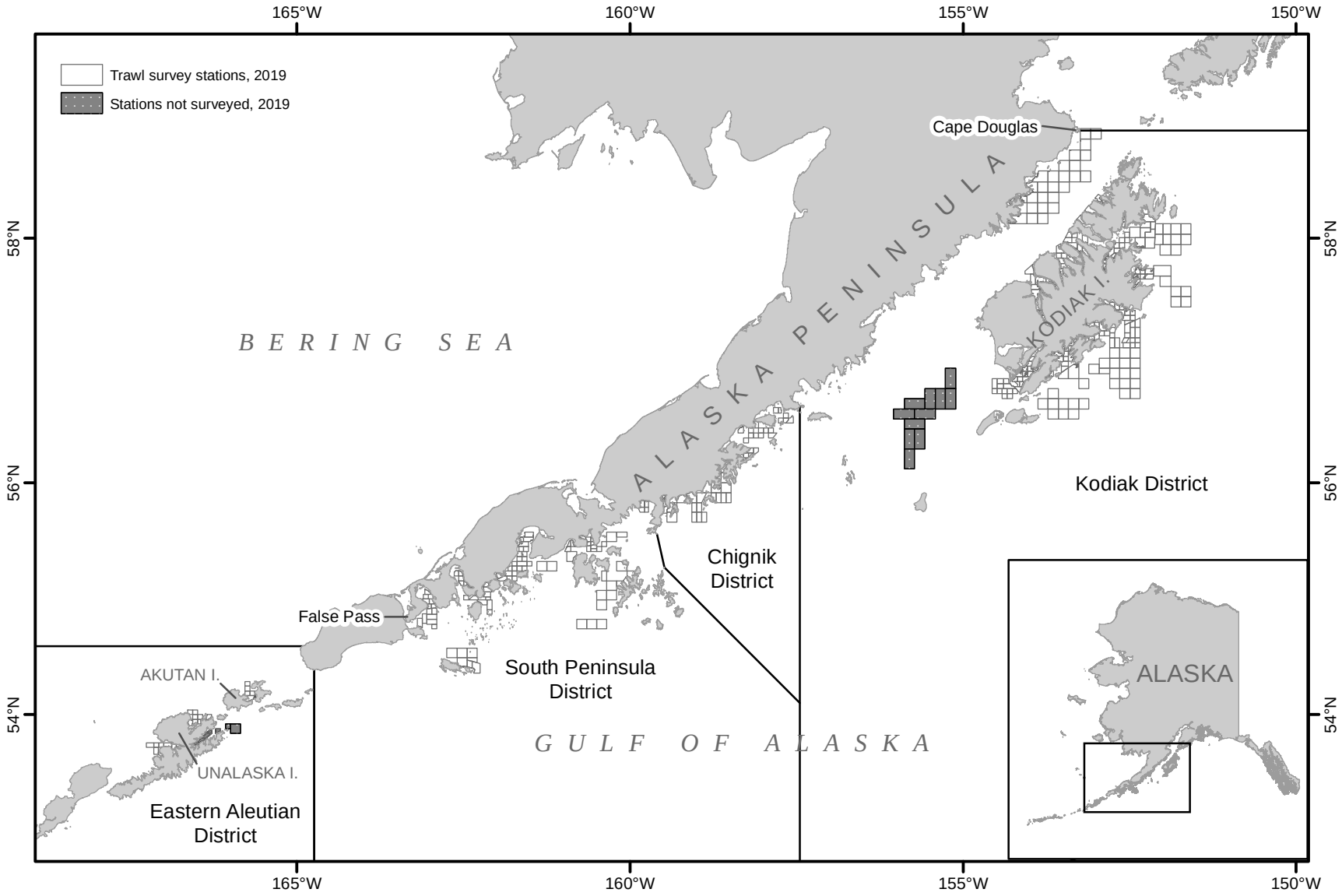


Figure 1.–Kodiak, Chignik, South Peninsula, and Eastern Aleutian districts large-mesh bottom trawl survey stations, 2019.

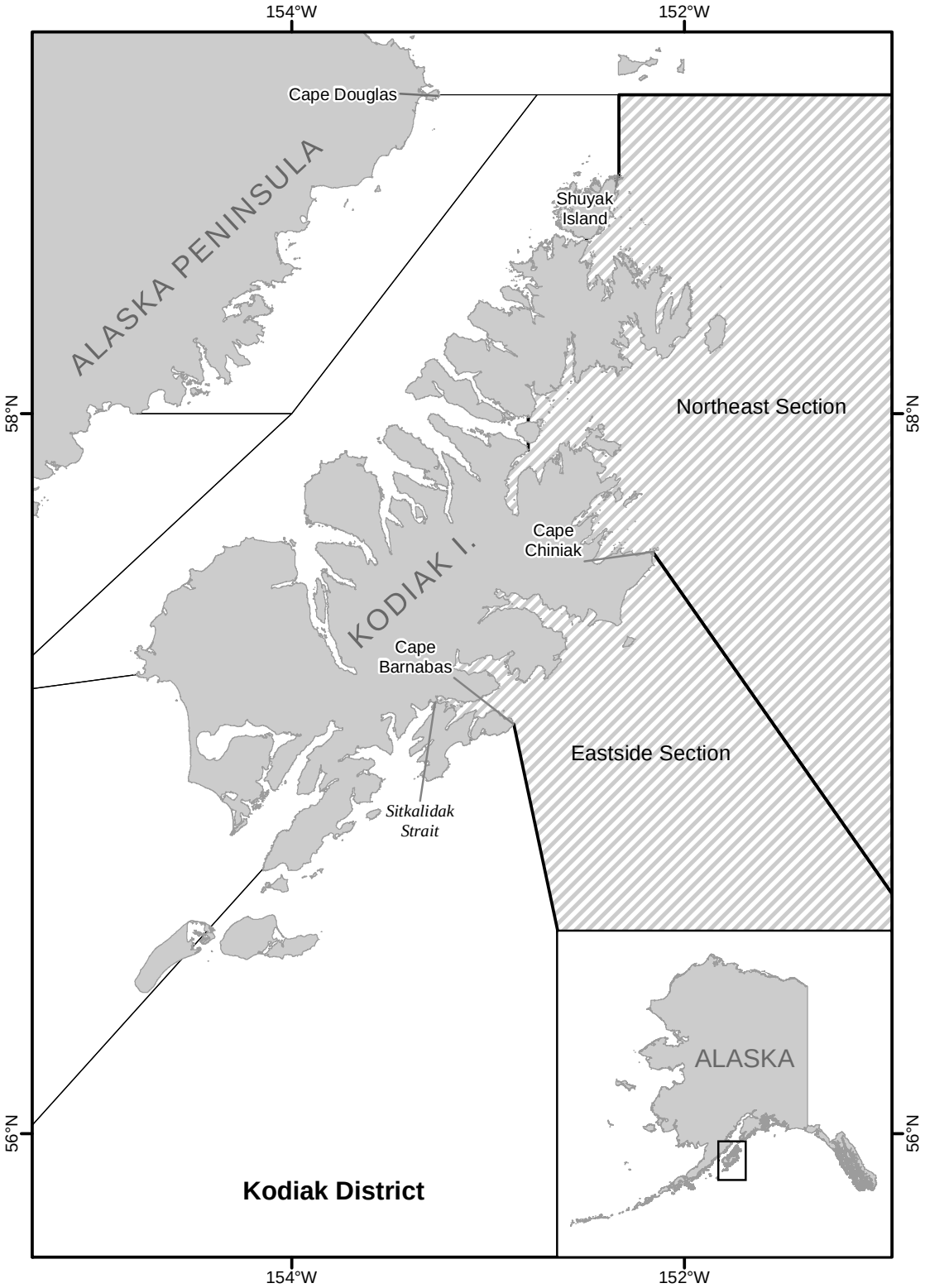


Figure 2.–Map of the Kodiak Tanner crab management District highlighting the Eastside and Northeast sections.

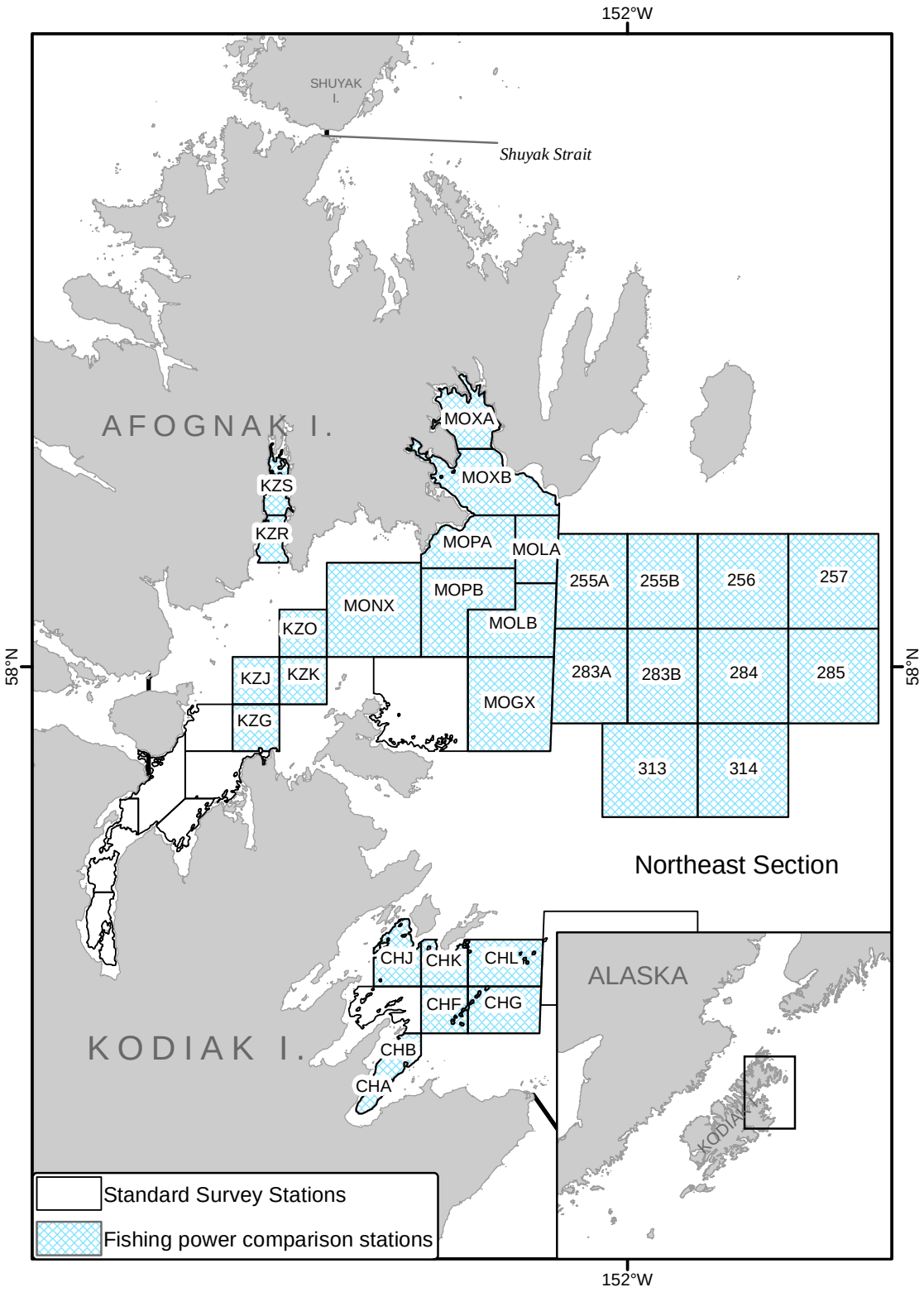


Figure 3.–Stations to be sampled during the 2019 fishing power comparison survey between the R/V *Resolution* and the R/V *Solstice* in the Northeast Section of the Kodiak Tanner crab District.

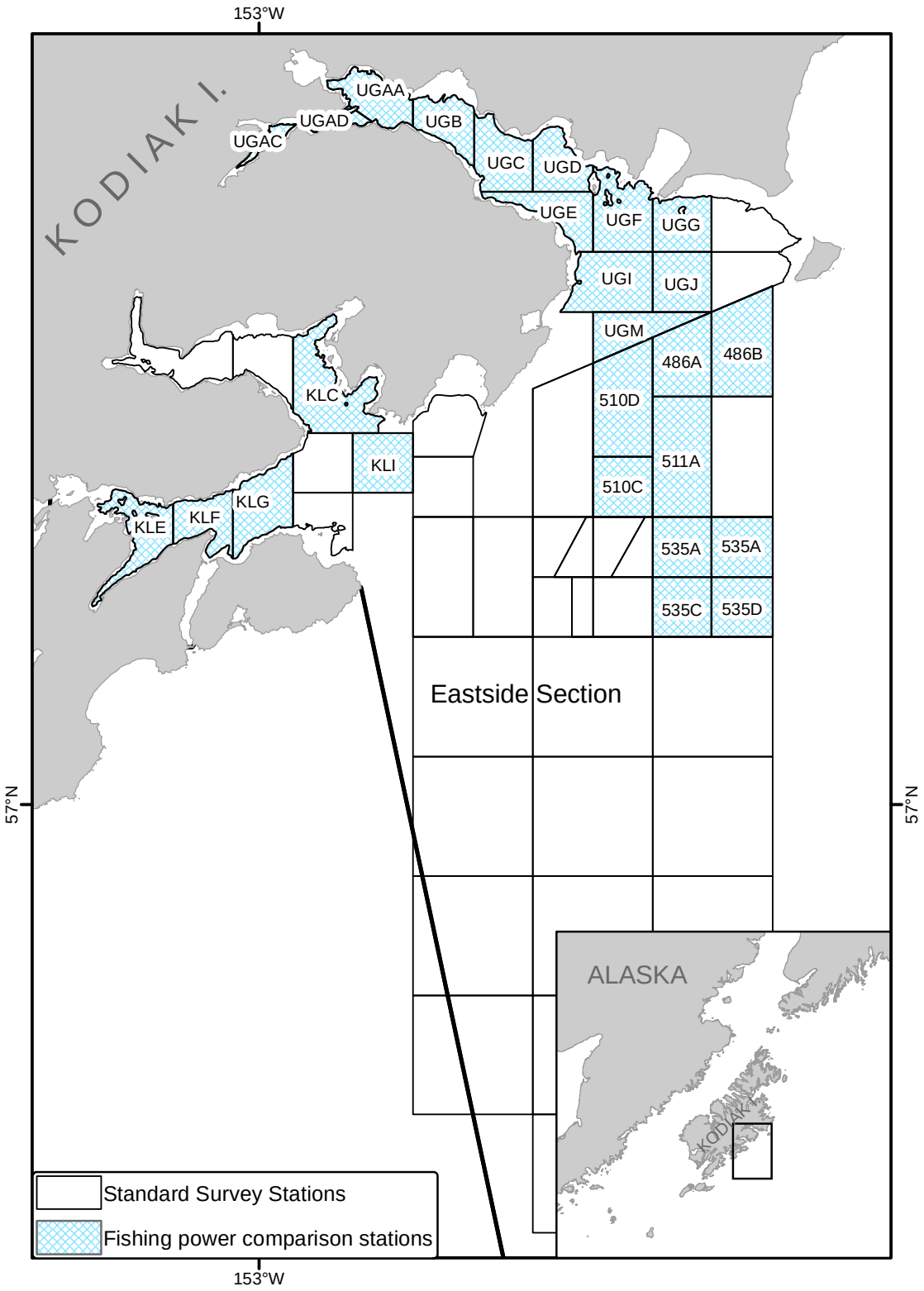


Figure 4.–Stations to be sampled during the 2019 fishing power comparison survey between the R/V *Resolution* and the R/V *Solstice* in the Eastside Section of the Kodiak Tanner crab District.

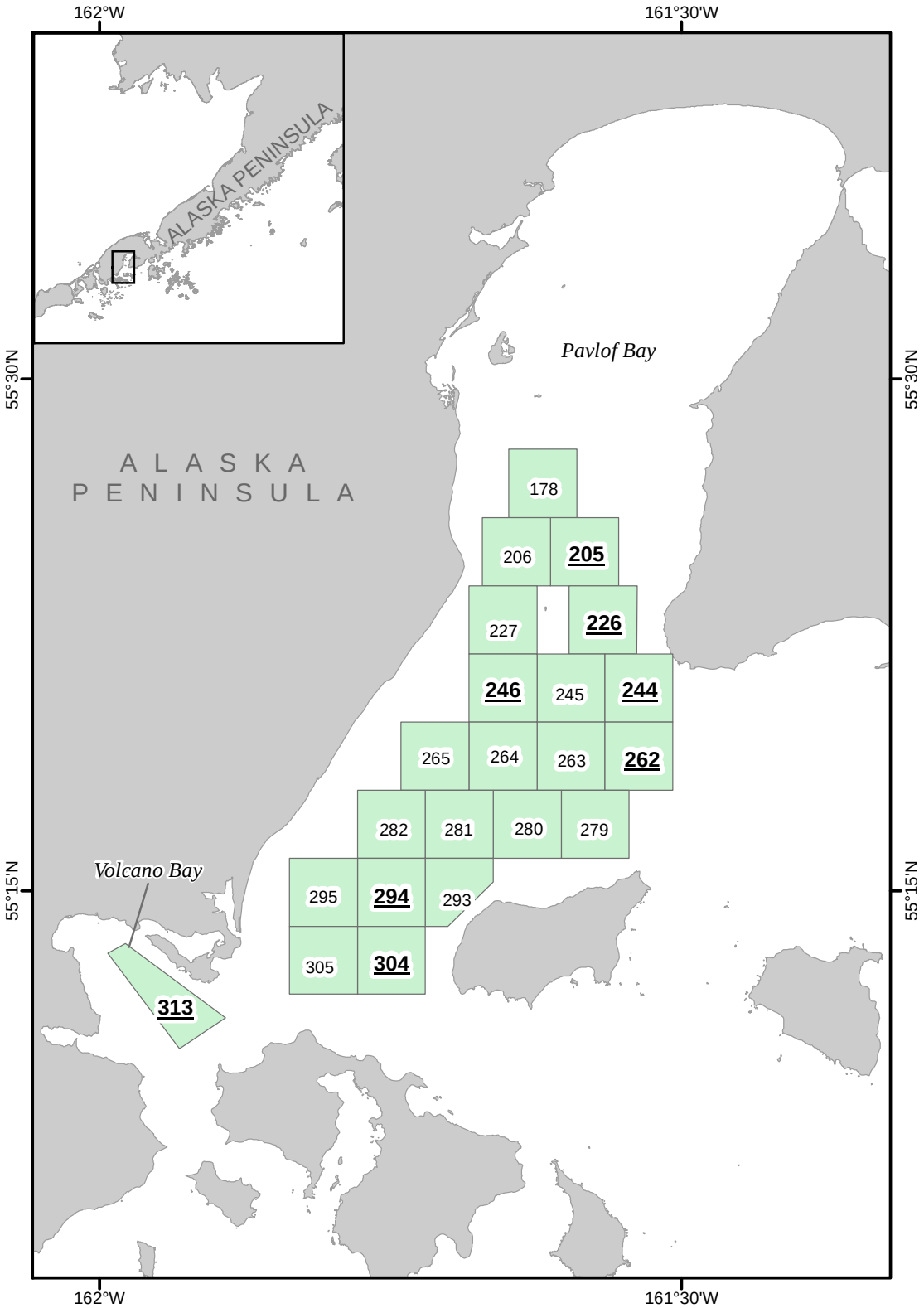


Figure 5.–Small-mesh trawl survey stations in Pavlof Bay. Stations in **bold** and underlined text will be towed in 2019.

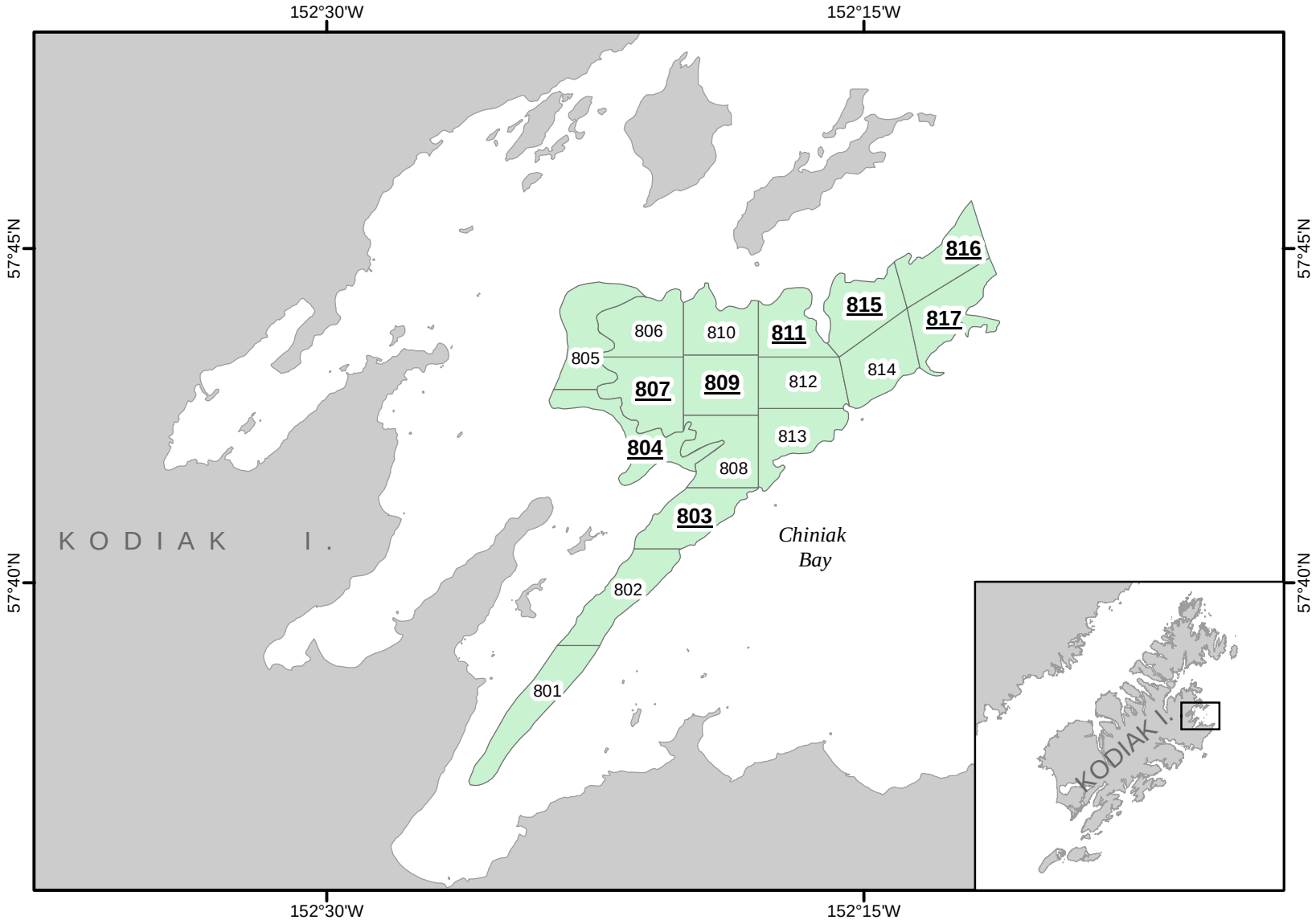


Figure 6.–Small-mesh trawl survey stations in Chiniak Bay. Stations in **bold** and underlined text will be towed in 2019.

APPENDIX A. SPECIAL PROJECT EQUIPMENT CHECKLIST

Fishing Power Comparison Study (R/V Solstice)

- Nautical charts of the area to be surveyed
- Large-mesh trawl nets (2)
- MSI-9300 crane scale
- Marel M1100 platform scale
- Magnetic fish measuring board
- Fish sampling computer
- Teguar waterproof computer with speakers
- Electronic calipers (3)
- Caliper cables (6)
- Laptop for data entry
- On-deck sampling forms
- Skipper trawl record forms
- Fish baskets
- Measuring tapes
- Navigational software for vessel
- Electronic file of survey stations for vessel navigational program
- Electronic file of trawl tracks from most recent surveys for navigational program

Pavlof/Chiniak small-mesh hauls

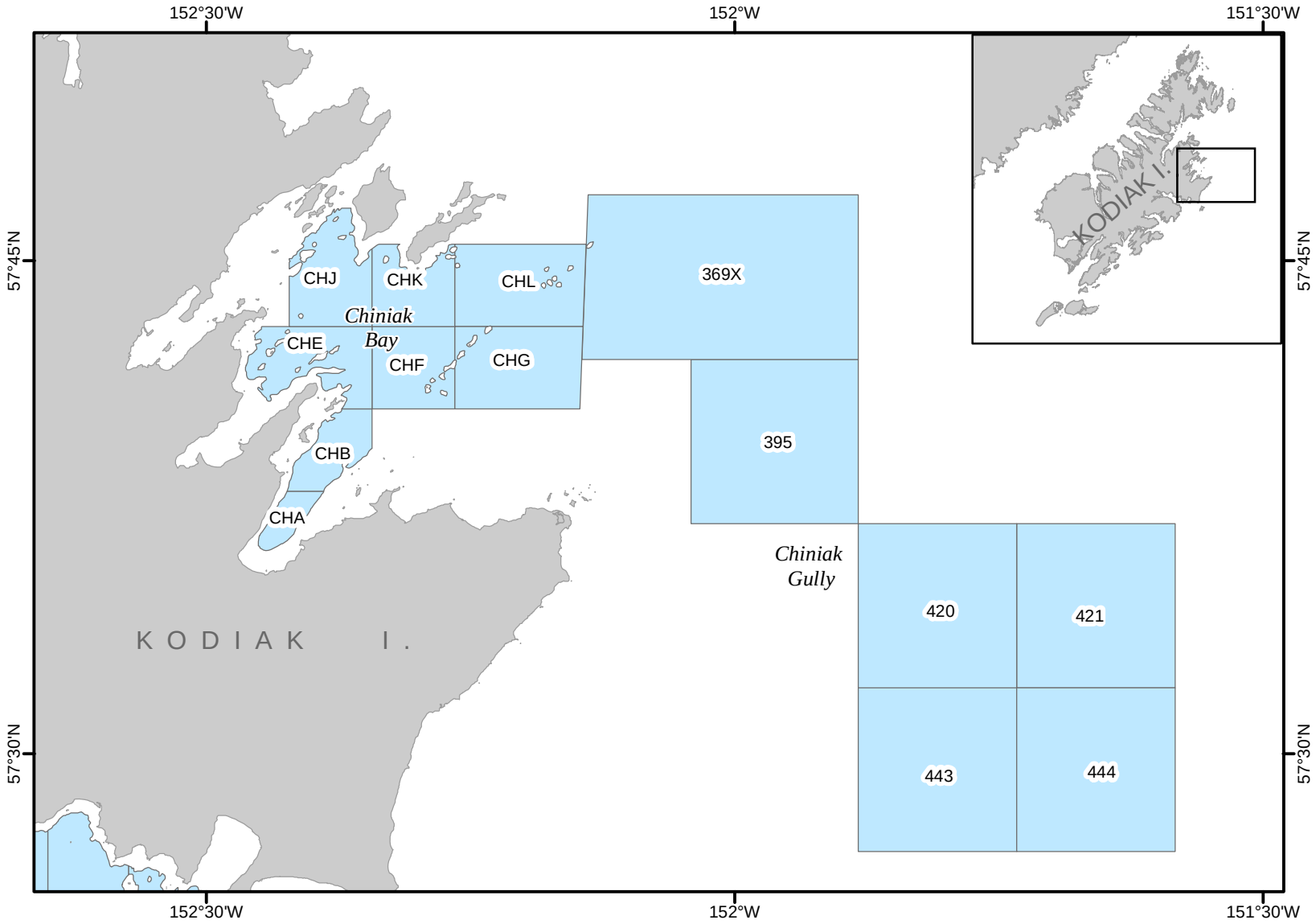
- Small-mesh trawl nets (2)
- Marel M60 platform scale
- 1-gallon Ziploc bags
- 1-quart Ziploc bags
- Small-mesh on-deck forms
- Electronic shrimp measurement database
- Digital camera

Tanner crab black eye pathology monitoring

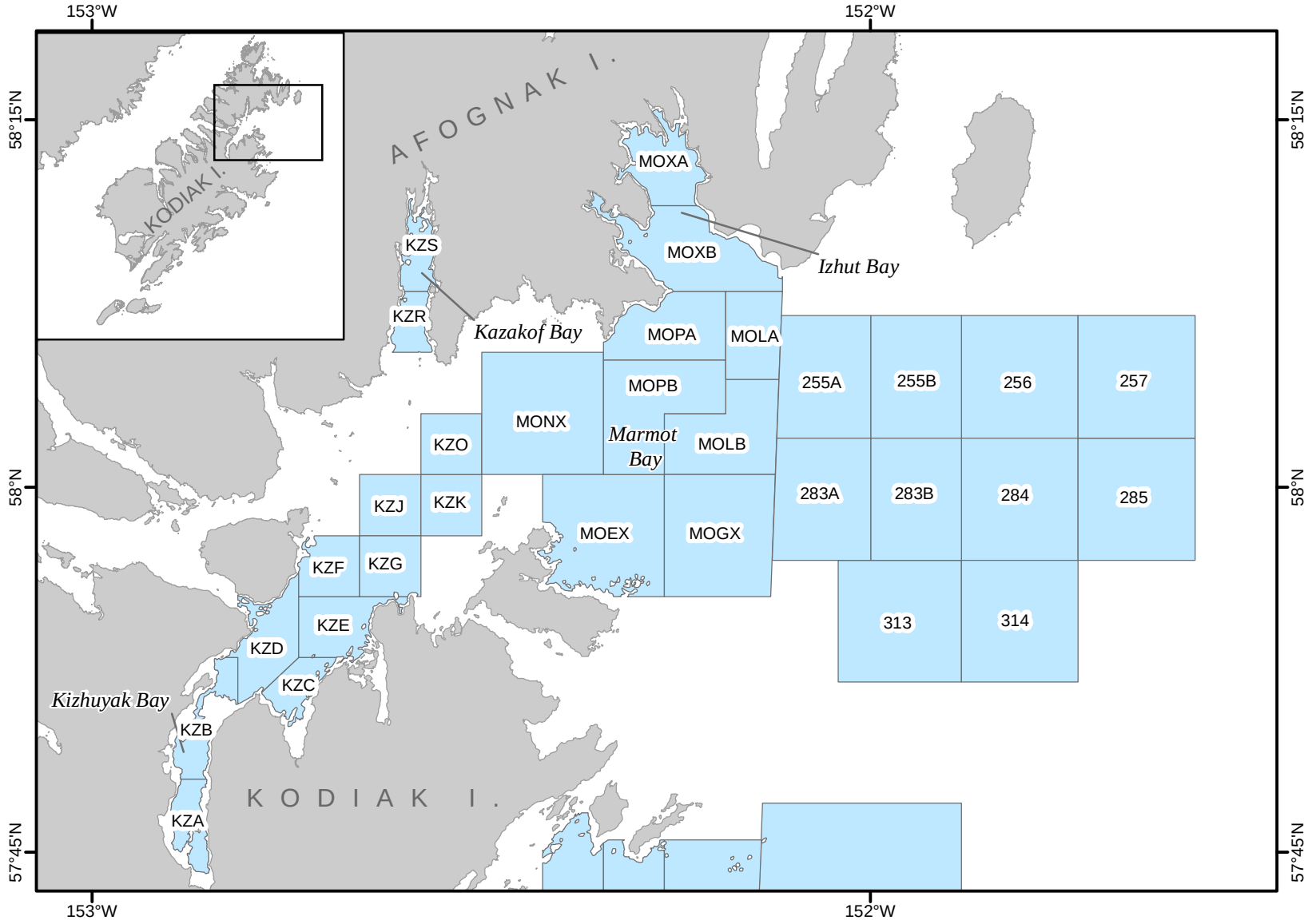
- On-deck pathology guides
- Hard copy waterproof data forms
- Digital calipers

APPENDIX B. TRAWL SURVEY STATION MAPS

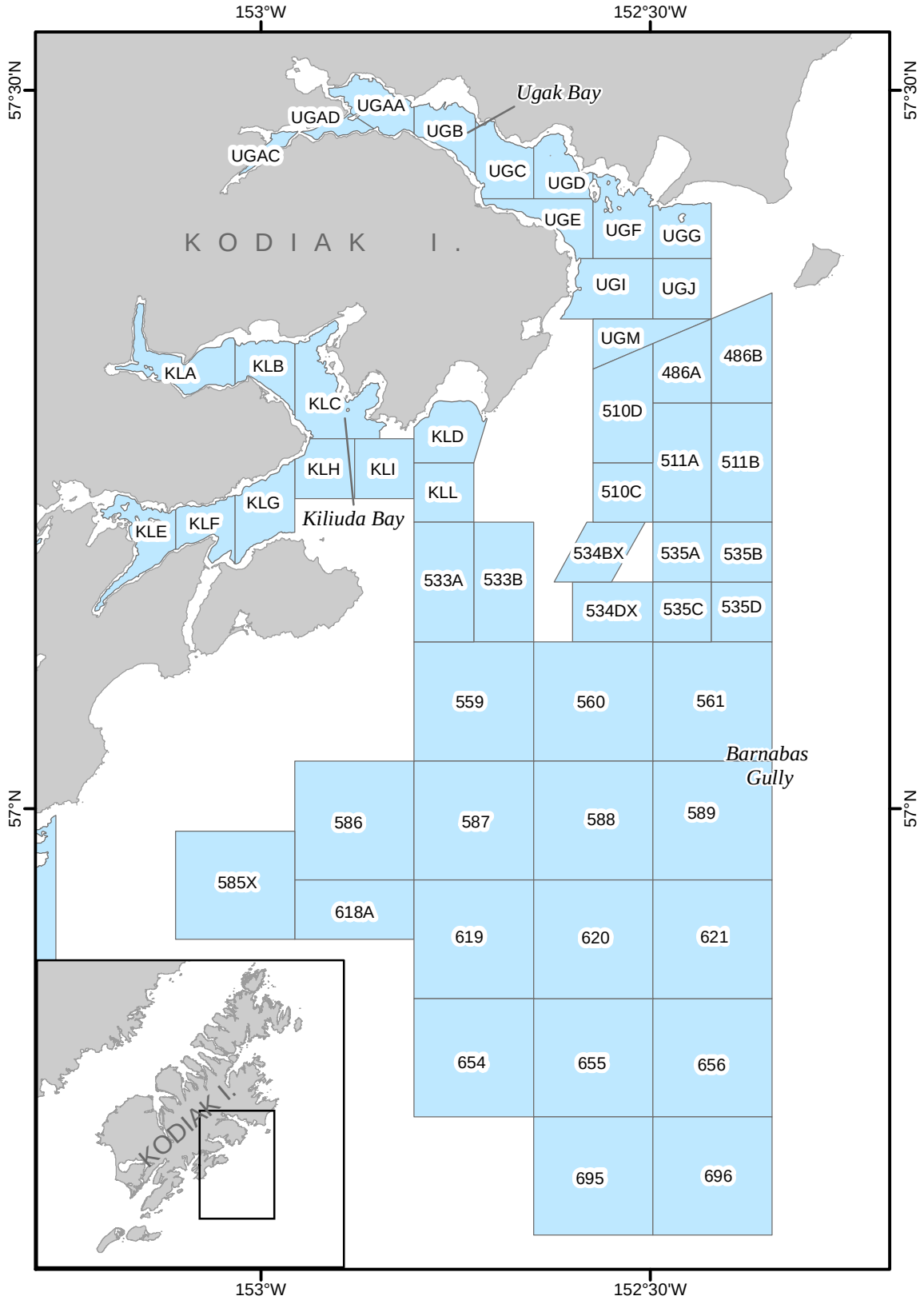
Appendix B1.–Station boundaries and names, Chiniak Bay and Chiniak Gully, 2019 Kodiak District trawl survey.



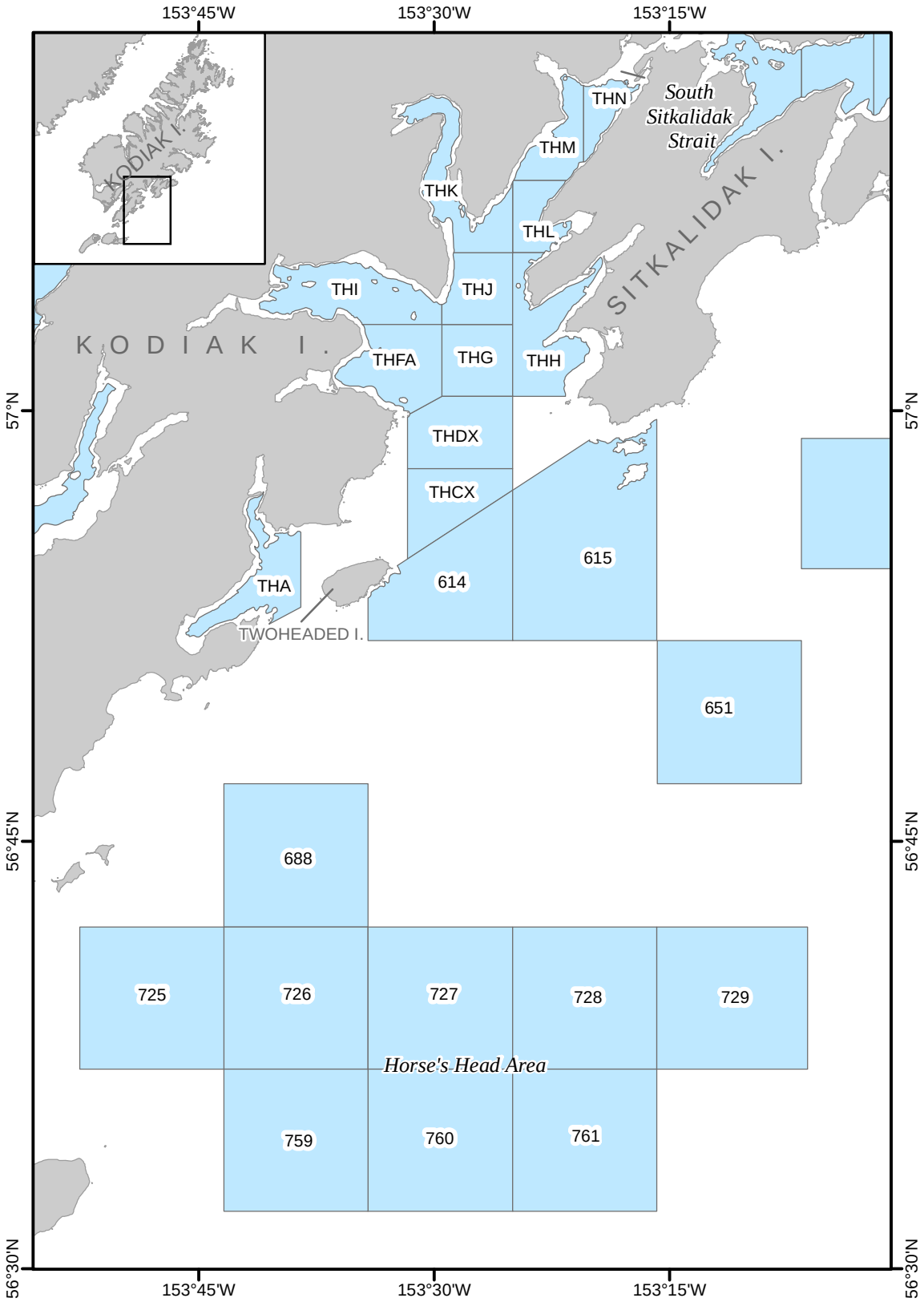
Appendix B2.–Station boundaries and names, Izhut, Kazakof, Kizhuyak, and Marmot bays, 2019 Kodiak District trawl survey.



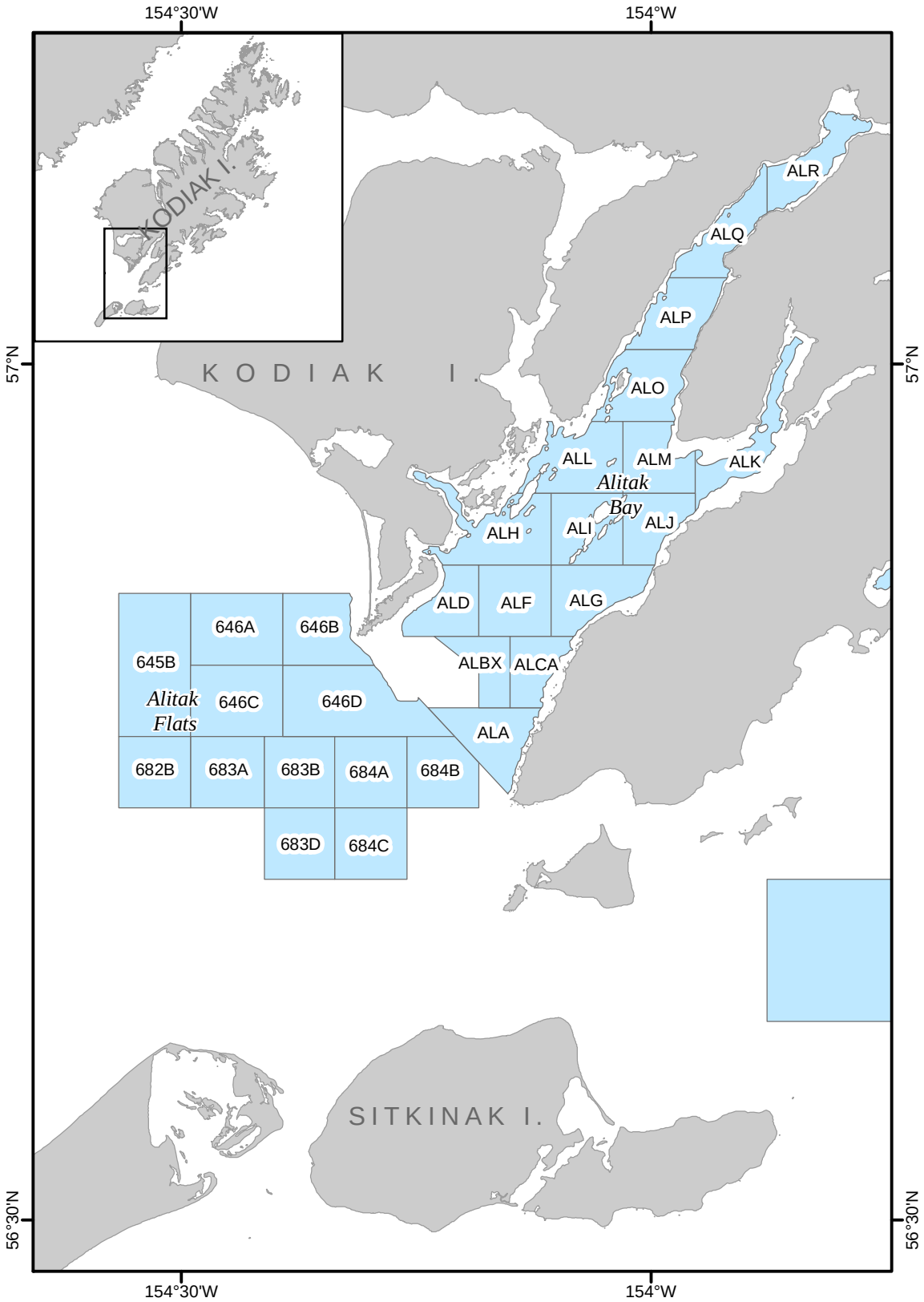
Appendix B3.–Station boundaries and names, Ugak Bay, Kiliuda Bay, and Barnabas Gully, 2019 Kodiak District trawl survey.



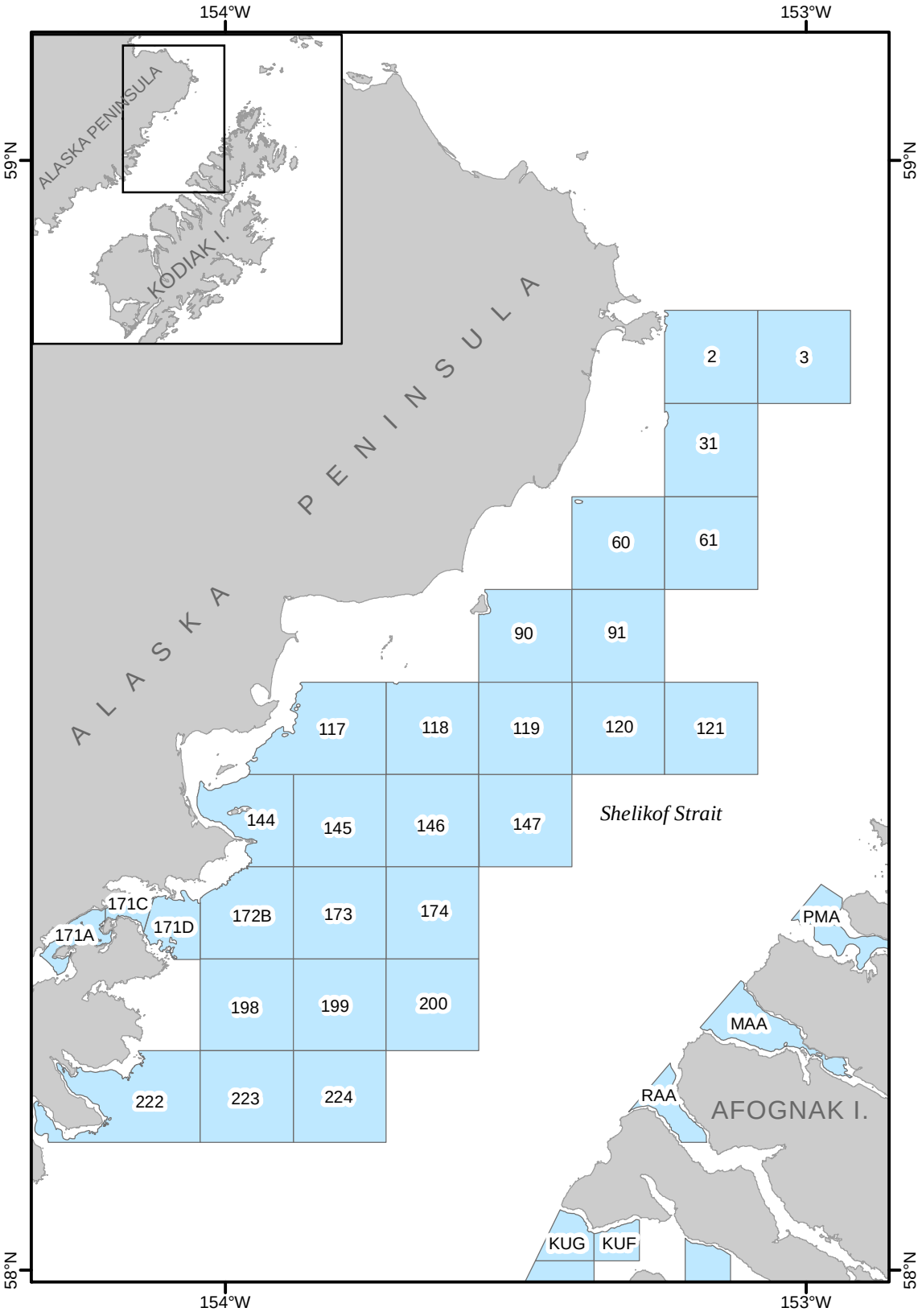
Appendix B4.–Station boundaries and names, South Sitkalidak Strait, Twoheaded Island, and Horse's Head area, 2019 Kodiak District trawl survey.



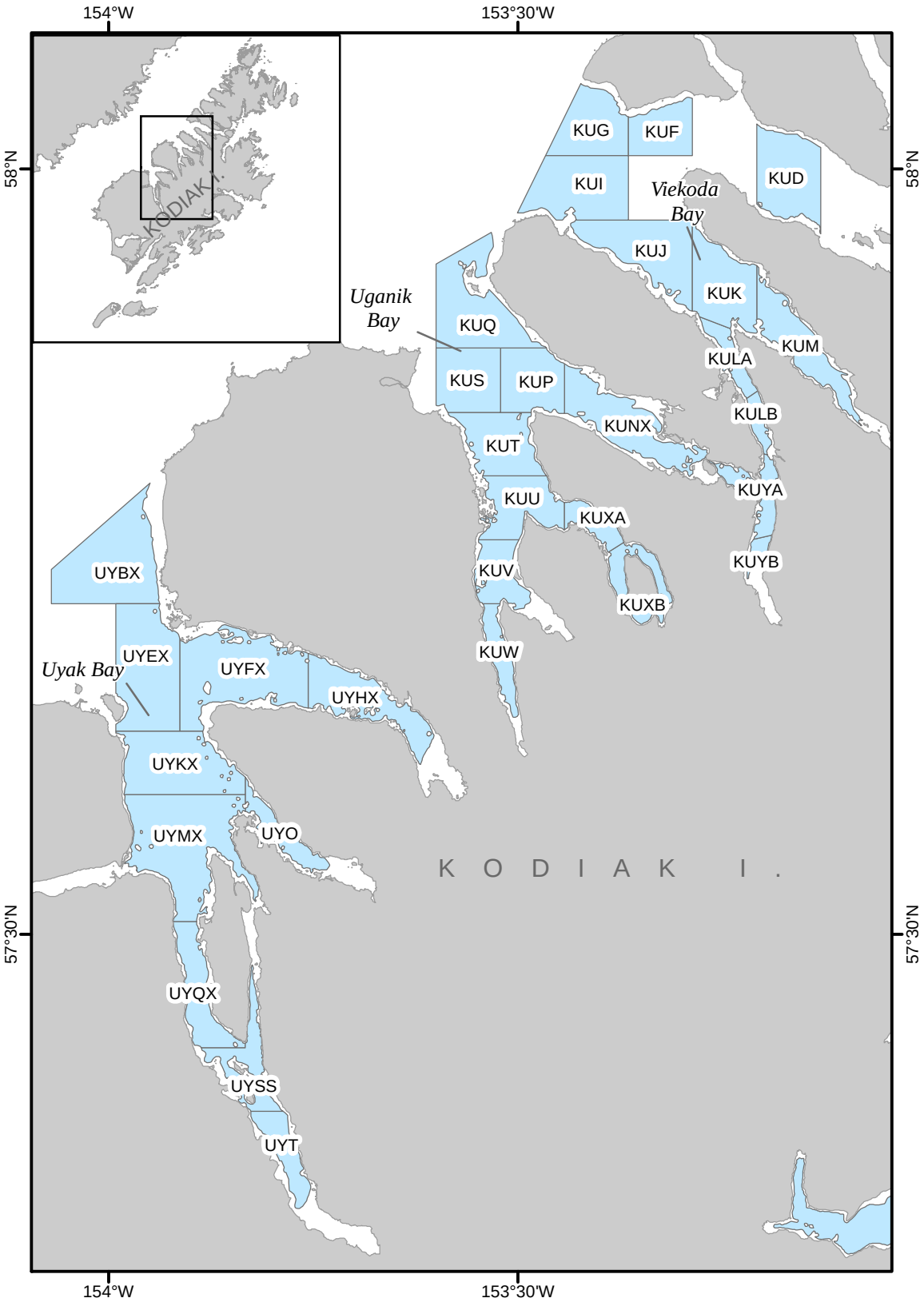
Appendix B5.–Station boundaries and names, Alitak Bay and Alitak Flats, 2019 Kodiak District trawl survey.



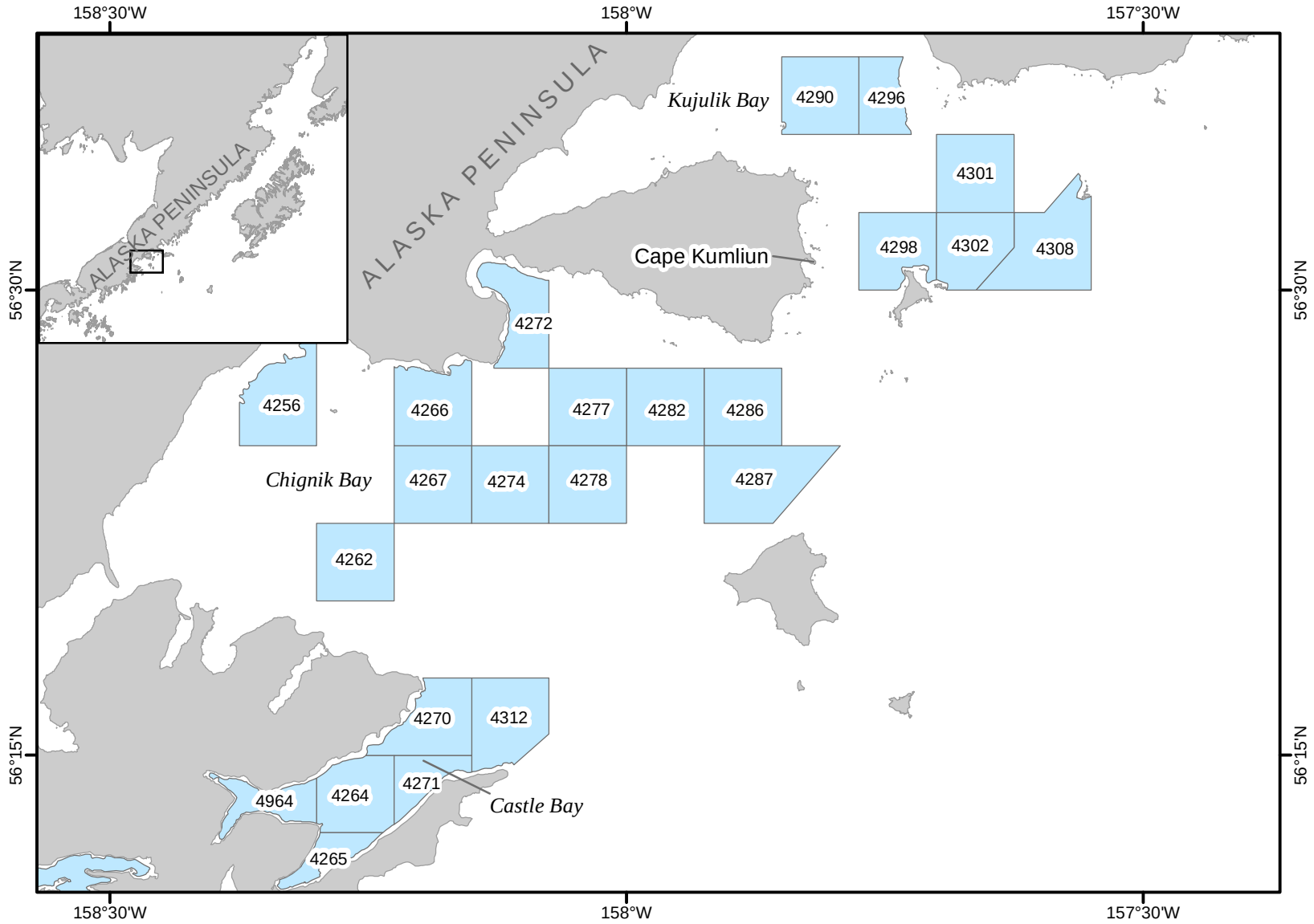
Appendix B6.–Station boundaries and names, Shelikof Strait and Afognak Island, 2019 Kodiak District trawl survey.



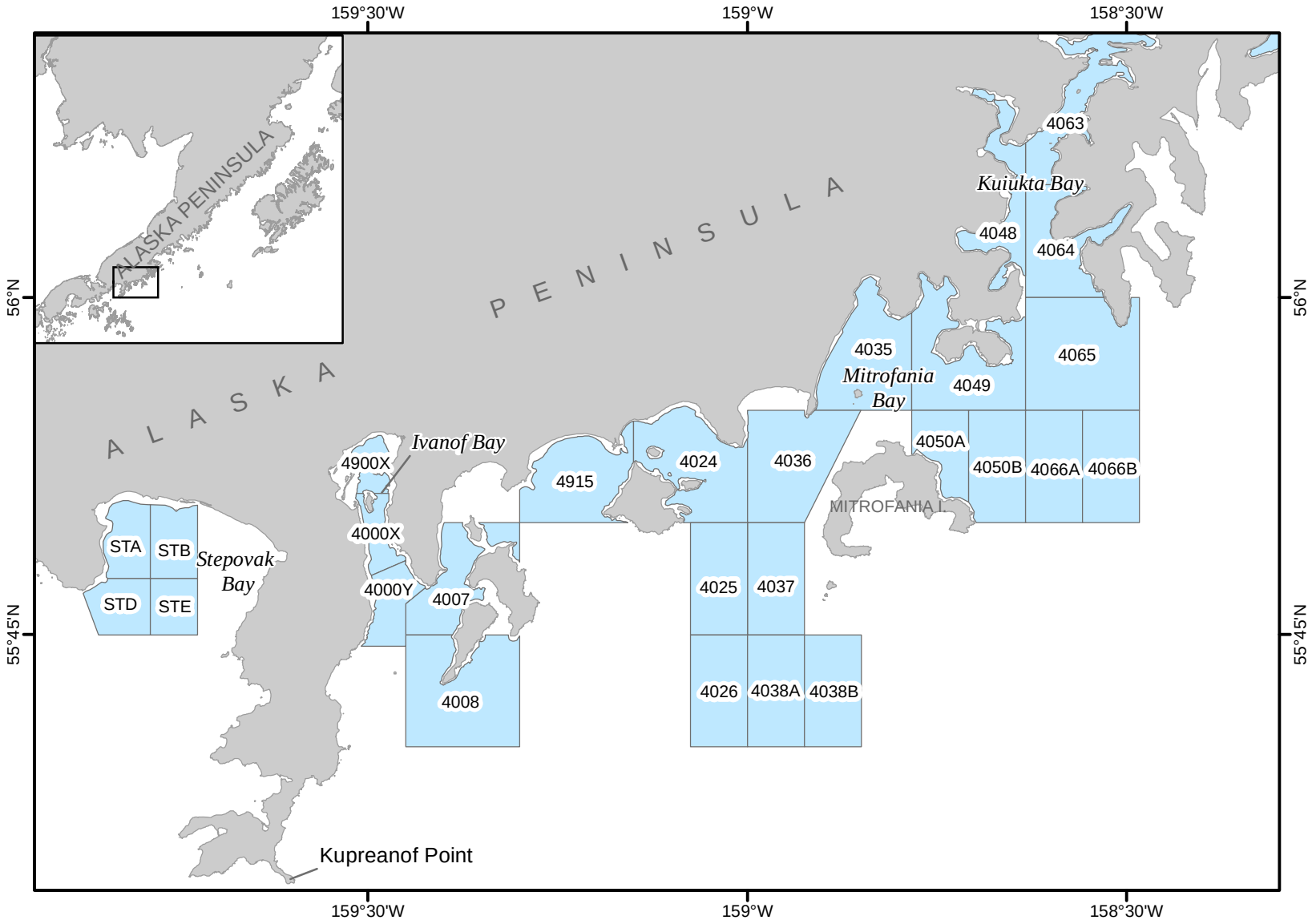
Appendix B7.–Station boundaries and names, Uyak, Uganik, and Viekoda bays, 2019 Kodiak District trawl survey.



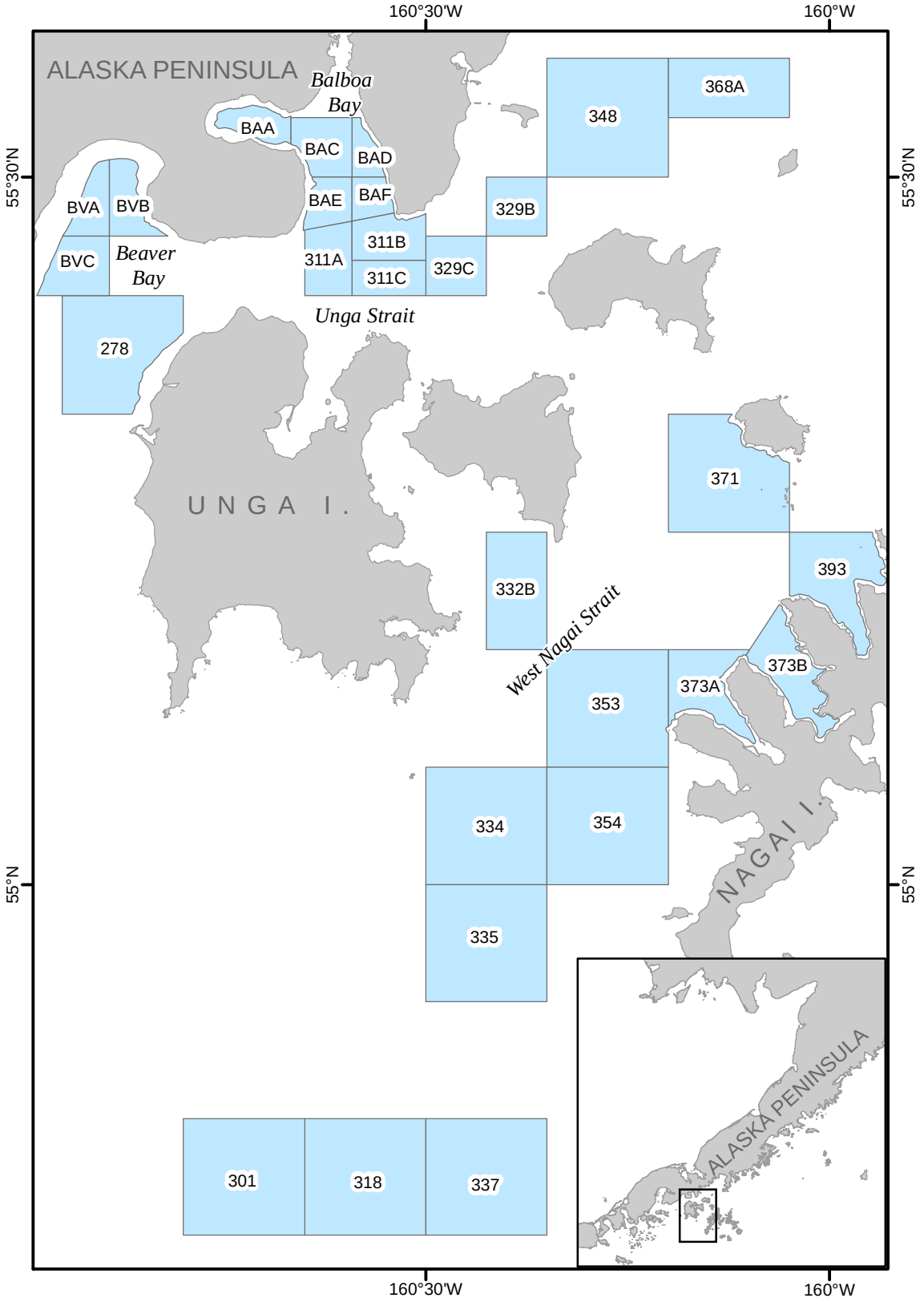
Appendix B8.–Station boundaries and names, Kujulik, Chignik, and Castle bays, 2019 Chignik District trawl survey.



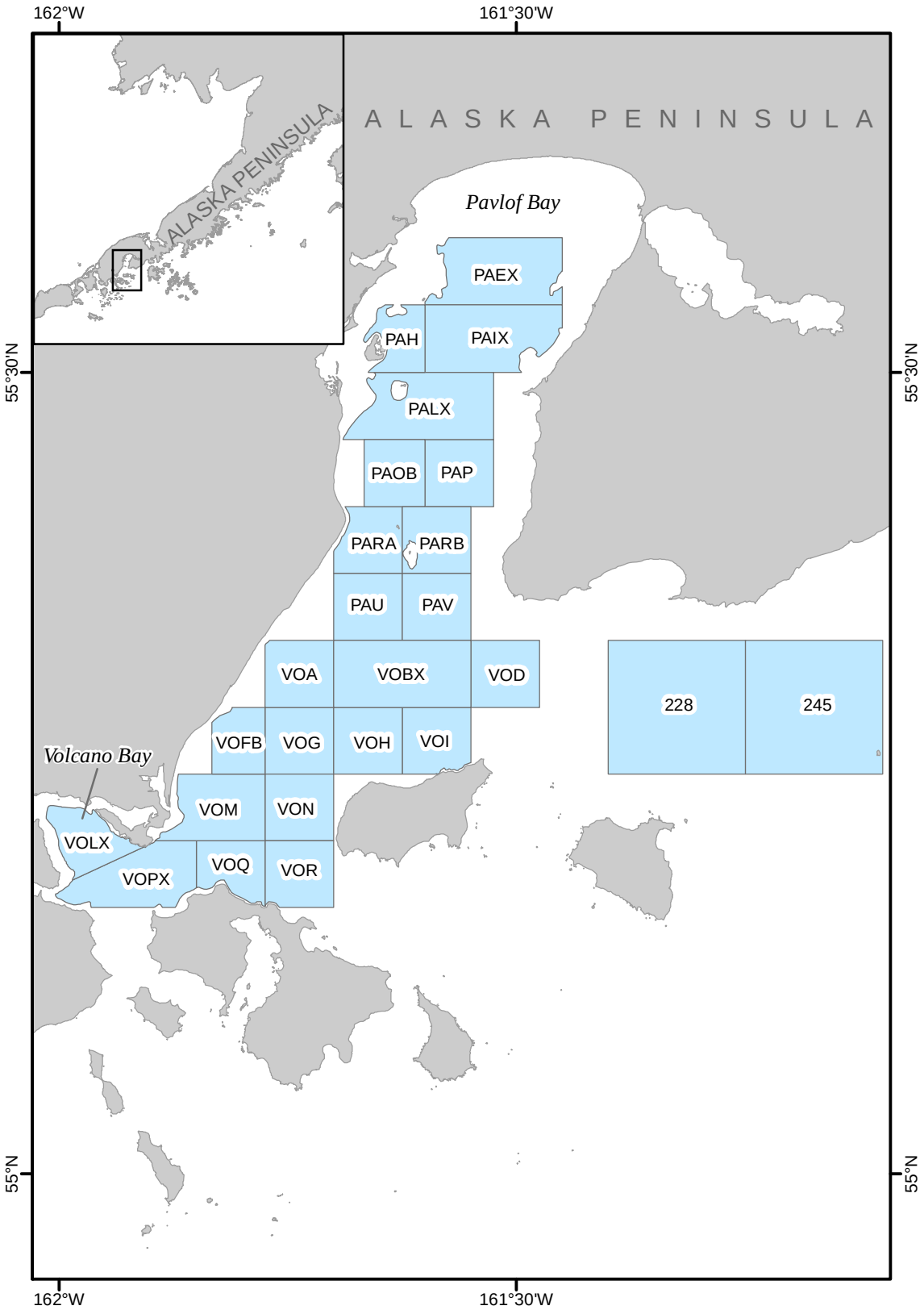
Appendix B9.–Station boundaries and names, Stepovak, Ivanof, Mitrofania, and Kuiukta bays, 2019 South Peninsula District and Chignik District trawl surveys.



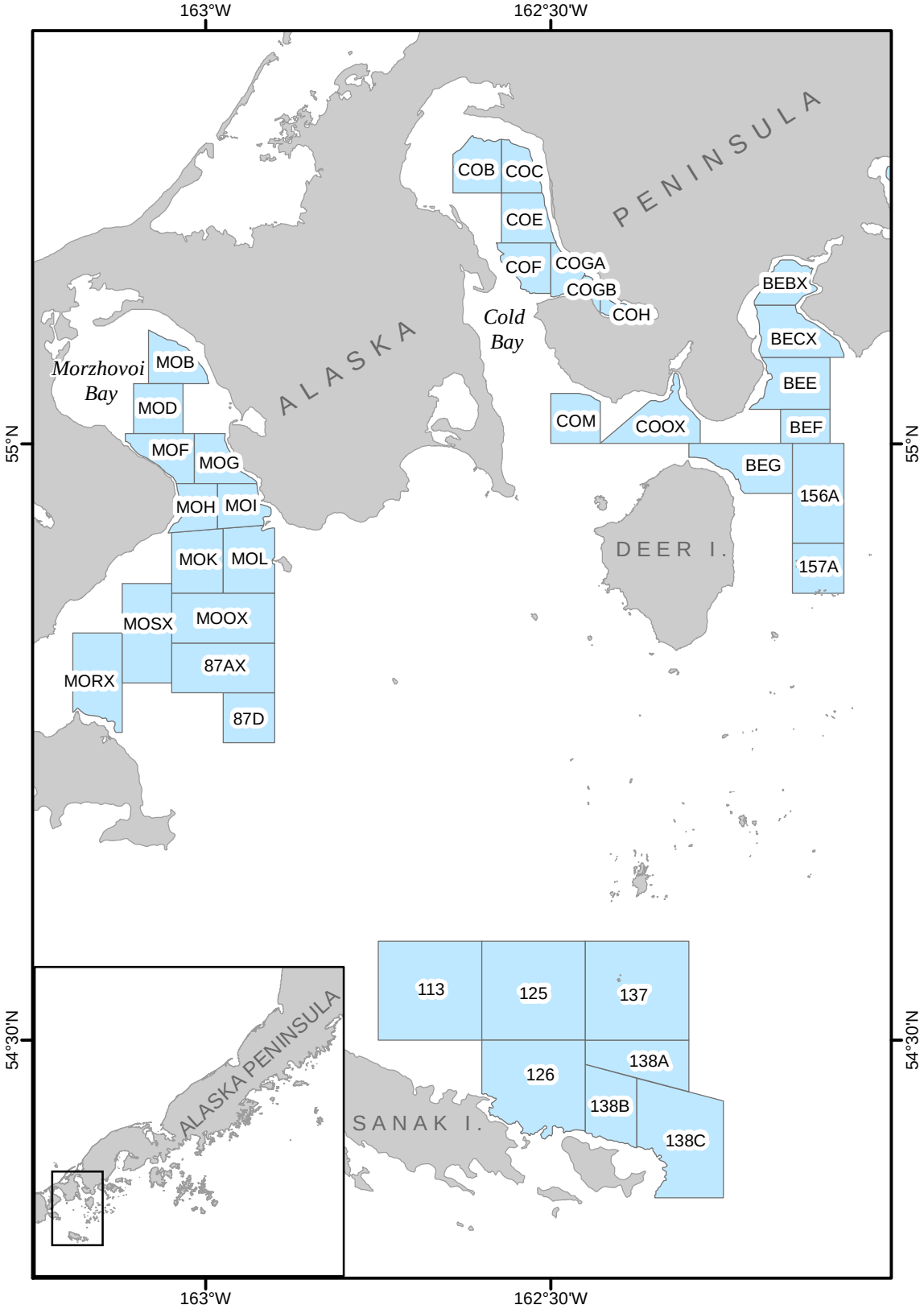
Appendix B10.–Station boundaries and names, Unga Strait, Beaver Bay, Balboa Bay, and West Nagai Strait, 2019 South Peninsula District trawl survey.



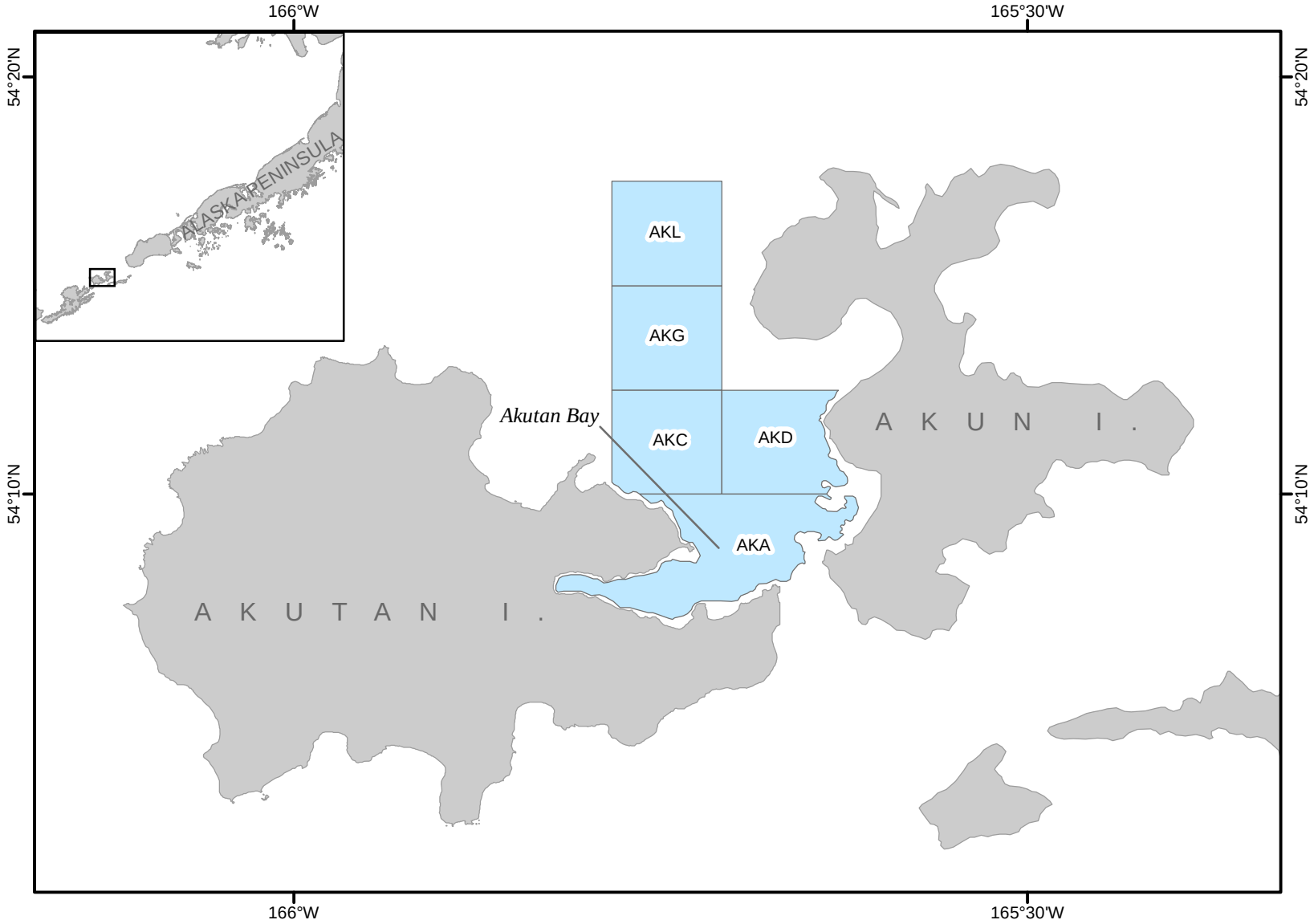
Appendix B11.–Station boundaries and names, Pavlof and Volcano bays, 2019 South Peninsula District trawl survey.



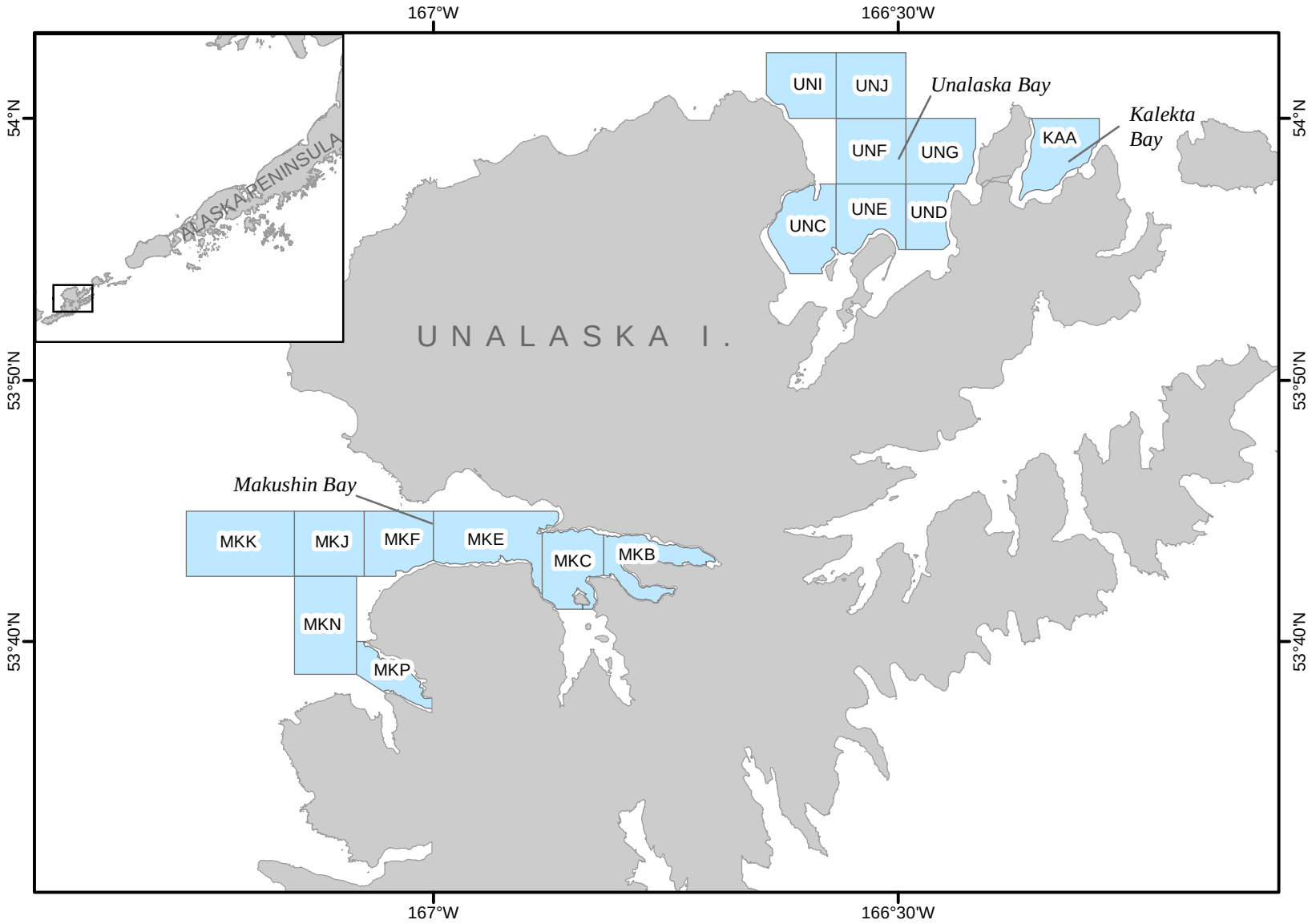
Appendix B12.–Station boundaries and names, Morzhovoi Bay, Cold Bay, Deer Island, and Sanak Island, 2019 South Peninsula District trawl survey.



Appendix B13.–Station boundaries and names, Akutan Bay, 2019 Eastern Aleutian District trawl survey.

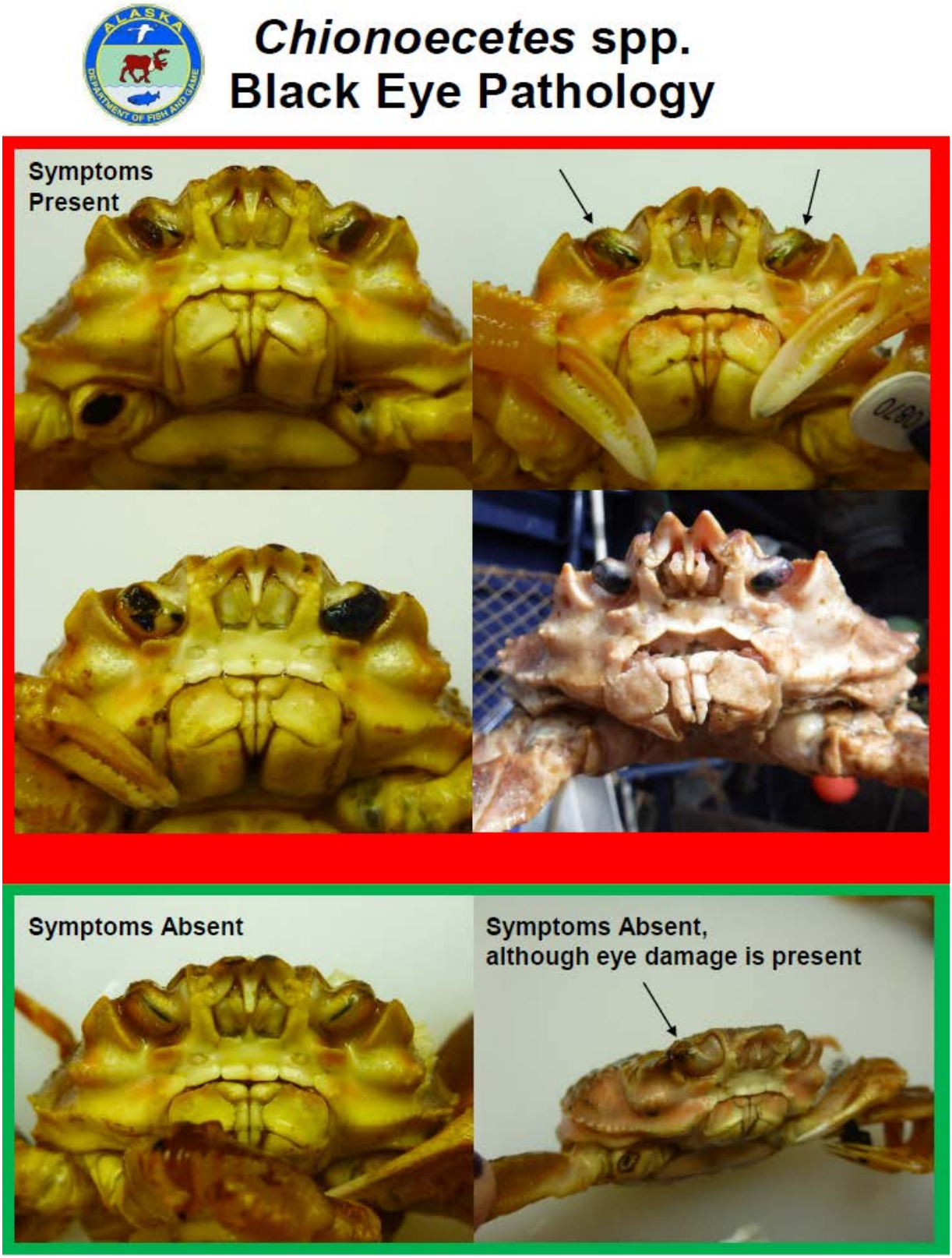


Appendix B14.–Station boundaries and names, Makushin, Unalaska, and Kalekta bays, 2019 Eastern Aleutian District trawl survey.



APPENDIX C. TANNER CRAB BLACK EYE PATHOLOGY MONITORING

Appendix C1.– Black Eye Pathology Monitoring Guide.



ADF&G Black Eye Pathology Monitoring Data Form

Vessel:_____ Leg:_____ Species:_____ Year:_____ Initials:_____

Black Eye Pathology Monitoring

Date	Haul	# Females Examined	# Males Examined	Crab Positive for Black Eye Present?	Date	Haul	# Females Examined	# Males Examined	Crab Positive for Black Eye Present?

Crab Information When Positive for Black Eye

Haul	Sex Code	Female Maturity	Shell Cond.	CW (mm)	Chela (males)	Eggs			Other Diseases	Comments
						Clutch Fullness	Clutch Cond.	Egg Dev.		

Sex Code	Female Maturity	Shell Condition	Eggs:			Other Diseases
			Clutch Fullness	Clutch Condition	Egg Development	
0=Unknown 1=male 2=female 3=hermaphrodite	0=Unknown 1=Juvenile 2=Mature	1=soft/new pliable 2=new 3=old 4=very old/very very old	0=Empty 1=Trace to 1/8 2=1/8 to 1/4 3=1/4 to1/2 4=1/2 to 3/4 5=3/4 to full	1=No dead eggs 2=Dead eggs < 20% 3=Dead eggs >20% 4=Barren, clean 5=Barren, matted 6=Barren, no setae	1=Uneyed eggs 2=Eyed eggs 3=Hatching-eyed eggs and empty egg cases	1=Parasitic barnacle 2=Nemertean worms 3=Bitter crab 4=Black Mat 5=Torch 6=Pepper crab 7=Leatherback

-continued-

ADF&G Black Eye Pathology Monitoring Data Form Instructions

Vessel	Name of vessel conducting survey
Leg	Leg of survey data was collected from
Species	Common name or scientific name of crab being examined (one species per form)
Year	Year survey is being conducted
Initials	Initials of person collecting data (if multiple people per page, write initials in margin next to haul)

Black Eye Pathology Monitoring

Date	Month and day when data is collected and recorded
Haul	Sequential number for haul that crab were collected from
# Females Examined	Total number of females examined for presence of black eye pathology from haul
# Males Examined	Total number of males examined for presence of black eye pathology from haul
Crab Positive for Black Eye Present?	Number of crab from haul that exhibited positive signs of black eye pathology

ADF&G Black Eye Pathology Monitoring Data Form Instructions (continued)

Crab Information When Positive for Black Eye

Haul	Sequential number for haul crab was collected from
Sex Code	Code (at bottom of form) for sex of crab sampled
Female Maturity	Code (at bottom of form) for maturity status of crab sampled, applies to female crab only
Shell Cond	Code (at bottom of form) describes the condition of crab shell, including wear, discoloration, epibionts, etc.
CW (mm)	Indicate carapace width excluding spines to nearest 0.01 millimeter
Chela (males)	Indicate height of right chela excluding spines to nearest 0.01 millimeter, applies to males crab only (regenerated chela not to be measured)
Eggs	
Clutch Fullness	Code (at bottom of form) describes the relative amount of eggs in the abdominal flap of adult female crab
Clutch Cond.	Code (at bottom of form) describes the physical condition of eggs in abdominal flap of adult female crab, or setae if eggs are not present
Egg Dev.	Code (at bottom of form) describes visible signs of egg development in the abdominal flap of adult female crab, if present
Other Diseases	Codes (at bottom of form) describes the most common parasites/diseases encountered during the survey other than black eye pathology; multiple codes may be listed; diseases or parasites not listed should be noted in comments column
Comments	Record comments related to crab sampled such as parasites, morbidity, regenerated chela, etc.